



Enhancing L2 Speaking Skills Through Technology: An Overview of Research Findings

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Received: 08 Apr 2024; Received in revised form: 10 May 2024; Accepted: 20 May 2024; Available online: 01 Jun, 2024

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Abstract— The efficacy of Technology-Enhanced Speaking Development (TESD) for enhancing second language (L2) speaking abilities was examined in this study. To determine the digital resources and instructional activities utilized in TESD, 58 research publications were examined. The study discovered 19 distinct learning activities that are employed in TESD and can be divided into four categories: guiding the use of speaking methods, facilitating speaking practice in spoken interactions, supporting speaking abilities in activities, and enhancing speaking knowledge. The results of the examined literature demonstrated that learner perception and academic achievement are typically improved by TESD interventions. Furthermore, a framework known as the Cognitive Schemata for Speaking Skills was put forth to direct the creation and execution of TESD initiatives. The study also noted difficulties with student motivation, instructor preparation, and access, and it suggests future research paths to deal with these problems.



Keywords— L2 speaking, TESD, digital resources, learning activities, and cognitive schema paradigm

I. INTRODUCTION

In L2 learning, the investigation of speaking ability improvement is a prevalent problem (Shahini & Shahamirian, 2017). L2 students aim to gain a comprehension of how to use spoken L2 in a variety of environments (Liao, 2009), which is crucial for everyday communication and the improvement of additional L2 abilities (Alrasheedi, 2020). This goes in addition to comprehending and gaining auditory knowledge from particular resources in specific settings. It is generally acknowledged that acquiring L2 speaking abilities is exceedingly challenging, necessitating extensive knowledge, the creation and rebuilding of cognitive schemata, a significant focus on management, and the coordination of intricate cognitive operations (Alimohamadi, & Poordaryiaenejad, 2015; Umaira, 2020). Given the significance and challenge of developing speaking proficiency in a foreign language, it is evident that there is an urgency to look into helpful activities and resources to enhance L2 speaking.

Since 2000, academics have been examining technology-enhanced L2 speaking development, or TESD, to address this demand (Shadiev & Yang, 2020). Speaking with instructors, who are often L2 speakers, has historically been the primary way that students have acquired their L2 speaking abilities (Pitura, 2022). In contrast to earlier methods that did not possess digital affordances, modern digital technology allows for the encapsulation of an enormous quantity of reliable English-speaking resources spoken by native speakers into efficient instructional assignments that let learners complete them at their preferred pace. This strategy leads to greater productivity in L2 speaking advancement (Blake, 2016; Payne, 2020).

Scholars have carried out meta-analyses, reviews and syntheses in addition to the expanding body of empirical studies on technology-enhanced speaking development (TESD) (e.g., Blake, 2016; Payne, 2020); but very few, if any, of these investigations have systematically emphasized explicitly on technologies for TESD. Thus, a thorough analysis of TESD applications can present a clear understanding of the tools available for speaking

enhancement, the findings of which may assist those involved in choosing the right tools for their usage. Furthermore, research has demonstrated that different activities have a distinct impact on the enhancement of L2 speaking skills (Chau, 2021), suggesting that instructors need to select the right work for TESD. So, once more, a whole picture may be provided by a systematic evaluation of TESD research from the standpoint of learning tasks. Furthermore, the results of TESD have not been thoroughly examined in many investigations. While certain investigators, like Blake (2016) and others, have emphasized the overall favorable outcomes of TESD, others, including Lim et al. (2022), have been less optimistic. A comprehensive examination of the empirical research on TESD is beneficial for elucidating the findings of prior TESD research, since these contradictory results may have caused uncertainty and reluctance among academics and practitioners to apply this learning strategy.

This led to a methodical evaluation of empirical studies on TESD by the researcher from 2000 to 2024, with an emphasis on digital technologies, learning objectives, and learning results. The author's objectives in conducting this review were to: (a) categorize the different kinds of online resources and technology-boosted learning activities for the improvement of L2 speaking; (b) evaluate TESD results; (c) create a TESD model; and (d) offer implications for further study. This review was led by three questions:

1. Which digital tools were employed in the development of L2 Speaking?
2. Which educational activities were used in the TESD?
3. What were the TESD findings?

II. LITERATURE REVIEW

2.1 L2 Speaking

Speaking in an L2 is an intricate cognitive task. It necessitates both top-down processing—where interpretation is guided by preexisting knowledge and expectations—and bottom-up processing, where students construct comprehension from individual sounds and words (Corps & Rabagliati, 2020). (Thio, 2005; Al-Mahrooqi & Tuzlukova, 2011). Tasks designed for learning must take this complexity into account. Tasks that are well-designed offer chances for meaningful input as well as output. Students gain by reading a variety of texts, including official discussions and informal exchanges, as they might affect how they use language and vocabulary. Deeper engagement and growth are promoted by "pushed output" assignments, which require learners to grapple with rather foreign concepts (Thio, 2005; Al-Mahrooqi & Tuzlukova, 2011).

As a normal aspect of spoken communication, negotiating meaning is essential to vocabulary growth and

understanding. Cooperation is required for tasks like "split information" exercises, which promote language acquisition and bargaining (Thio, 2005; Al-Mahrooqi & Tuzlukova, 2011). But L2 speaking comes with a lot of difficulties. Sensitive aspects of identification such as age, first language, and even motivation affect pronunciation (Derwing & Munro, 2005). Although paying careful attention to pronunciation is crucial, other elements of fluency development should also be taken into consideration (Derwing & Munro, 2005). Assessing speaking ability is still difficult. While alternate approaches, such as group discussions, show potential but need further investigation, traditional examinations lack rater consistency (Thio, 2005; Al-Mahrooqi & Tuzlukova, 2011).

Technology presents fascinating opportunities. Speaking assessments that are graded by a computer may offer useful screening resources (Thio, 2005). Future studies on L2 speaking will focus on examining how well technology-enhanced activities work, how task design affects fluency development, and how speaking contributes to vocabulary expansion. L2 speaking training will become even more beneficial for students aiming to improve their fluency and communication abilities as study on the subject develops.

2.2 Previous Studies on TESD

Lys (2013) gives an example of how using iPads in a conversation lesson aided in the development of L2 speaking. The task-based, learner-centered approach that makes use of iPads is consistent with a paradigm that incorporates learning techniques and cognitive schema. Students probably engaged prior knowledge (schema) about the topic of the talk by working on assignments on iPads. Additionally, the iPads gave them the chance to practice new learning techniques (such as recording and evaluating discussions) to get better at speaking. This study emphasizes how technology may be used to foster a supportive atmosphere in which students actively apply their prior knowledge to establish focused speaking development plans.

The potential of technology, especially virtual reality (VR), to lessen L2 speaking anxiety (PSA) is highlighted by Chen (2022). Despite equal performance outcomes, their findings imply that VR may be more beneficial than mobile-assisted learning for lowering PSA. It's interesting to note that using technology tends to mitigate the effects of individual anxiety variations, indicating that technology can help students who experience different levels of worry. This is consistent with the idea of incorporating learning techniques (focused approaches) and cognitive schema (pre-existing knowledge) into a technology-enhanced model. Technology can boost speech

development and tailor the learning process by attending to individual requirements and worries.

González and Hardison (2022) present how the multimodal L2 pronunciation tool Assistive Design for English Phonetic Tools (ADEPT) enhances speaking development. This is consistent with a paradigm that combines learning techniques with cognitive schema. By giving students access to several representations of the IPA symbols—visual, aural, and tactile—ADEPT is likely to activate their prior understanding of sounds, or schemas. The website also provides explanations and recordings, which may encourage students to create focused practice plans (rehearsing certain sounds) to improve their pronunciation accuracy. This study shows that by providing a variety of channels for engaging with pronunciation principles and developing targeted learning.

Jaramillo Cherrez and Nadolny (2023) employ asynchronous video talks to illustrate the efficacy of technology in supporting L2 speaking development. Their mixed-methods study found a connection between video conversations better speech performance and a greater willingness to interact. This is consistent with a paradigm that combines learning processes with cognitive schema. To accomplish the assignment, learners were likely to create communication skills (drafting questions) while also activating prior knowledge about the issue through video chats. This shows that technology may improve speaking by promoting language use that is active and social by nature.

According to Zou et al. (2023), the integrated model of technology acceptability may be used to study the user acceptability of L2 speaking tools that are driven by AI. Their research indicates that learners' intentions to utilize an AI speech assessment system were positively affected by their perception of the system's utility and enjoyment. This aligns with a model that blends cognitive schema and learning strategies. Learners are more likely to interact with an AI tool and activate their schema about the target language if they find it entertaining and useful. The comments provided by the AI can subsequently help students create focused learning plans such as practicing areas of weakness to enhance their speaking. This study emphasizes how crucial user-centered design is to improving the efficacy of AI technologies for L2 speaking development.

Shabani and Jabbari (2023) draw attention to the potential benefits of online flipped classrooms for the development of L2 speaking, especially those that include interaction. According to their research, speaking improved more with interaction-embedded (IE) online flipped education than with interaction-reduced (IR) instruction. This is in line with an approach that mixes cognitive schema

with methods for learning. Student-centered engagement in the IE class probably triggered the schema of the language. Moreover, discussions and collaboration may have encouraged students to use targeted learning strategies such as posing queries and putting forth arguments to enhance their speaking skills. According to this study, flipped classes conducted online can provide a social learning environment in which students actively interact with their schema and build strategies.

Metrak (2024) draws attention to the potential of mobile learning (MALL) in the development of L2 pronunciation. According to their review, learners' attitudes and pronunciation were positively changed by smartphone applications. This is in line with a model that combines cognitive frameworks with methods for learning. MALL applications probably give students quick access to resources for pronouncing words (pictures, audio), which may help them recall their prior sound knowledge. These applications can also include interactive activities and feedback systems, which encourage students to create focused learning strategies (self-recording and pronunciation comparisons) to increase their speaking accuracy. According to this study, mobile technology can help to improve pronunciation by facilitating active interaction with target sounds and providing accessible learning tools.

Shafiee Rad (2024) is in favor of using AI-powered language-learning applications, such as Speeko, to enhance L2 speaking. The results show that using Speeko, as opposed to traditional approaches, improved speaking skills, willingness to communicate, and favorable perceptions. This makes sense for a paradigm that blends instructional methods with logical concepts. By offering tailored practice and feedback, Speeko probably activates schema about the language of interest. Furthermore, because the app is interactive, users may be encouraged to create focused learning techniques (practicing areas of difficulty, getting feedback, and modifying pronunciation). This work demonstrates how AI may be used to design tailored learning environments that take into account schema and promote the development of speaking strategies.

Discussion panels are shown to be beneficial in fostering the development of L2 speaking and having an impact on learner autonomy, growth attitude, and willingness to communicate (WTC) by Cao and Liu (2024). This makes obvious for a structure that combines rational notions with teaching strategies. Discussion panels' interaction with themes is likely to activate schema about the target language. Furthermore, the necessity of participation and teamwork may encourage students to

create focused learning techniques such as developing arguments or employing transition words to successfully convey their thoughts. This study demonstrates how discussion panels may support the development of a social learning environment in which students actively employ their schema and acquire communication techniques via interaction.

III. METHODOLOGY

The evaluation was carried out using the conventional three-step process of analyzing the data, evaluation, and selection. On January 11th, 2024, the researcher searched the "Web of Science Core Collection" for publications, selecting "article" as the record sort and "English" as the language. Because technological opportunities have been employed more often in L2 learning after 2000, the period selected "from 2000-01-01 to the present" (Shadiev & Yang, 2020). The study was carried out on studies listed by the "Social Sciences Citation Index (SSCI)", "Sciences Citation Index (SCI)", and the "Sciences Citation Index Expanded (SCI-E)", by numerous previous evaluations in the area of technology-assisted language acquisition. This was done because papers included in the SSCI/SCI/SCI-E are typically subjected to thorough peer review employing strict standards and have a significant impact (Duman et al., 2015). After the search, the author found 524 papers, from

which the researcher chose articles using seven screening criteria (see Table 1). After screening the papers based on their titles and abstracts, the author promptly eliminated 97 publications that had no bearing on the development of L2 speaking, in addition to 23 articles whose complete texts were not accessible online. The primary texts of the remaining 404 articles were then reviewed to evaluate them. Initially, 290 papers that did not include empirical findings on TESD were eliminated by the researcher. After that, forty more papers that addressed the gaining of audio data from particular resources in particular contexts were disqualified since the researcher's evaluation was limited to speaking abilities in general. Additionally, fourteen additional papers that lacked a clear explanation of the TESD implementation procedures and results were eliminated. Ultimately, the author eliminated four further publications that emphasized pupils with special needs considering the significant differences in schooling between this student demographic and the general pupil population (Scott & Windsor, 2000). As a result, 56 papers total—58 individual studies—were left after screening (see the asterisk-marked References for further information). Adopting a "Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)" 2020 flow diagram (<http://prismastatement.org/prismastatement/flowdiagram.aspx>), Figure 1 shows the steps involved in identifying and screening articles.

Table 1: Article Choice: Inclusion and Exclusion Basis

Factors	Inclusion	Exclusion
Title and abstract-based selection	Relevance to L2 speaking improvement	Lack of online full-text availability
Filtering according to primary literature	Presenting on empirical research on TESD	Emphasizing the obtaining of auditory data from certain resources in particular contexts exclusively
	Giving precise information about the execution procedures and results of TESD	Emphasizing pupils with unique requirements

Based on three codes that corresponded to the RQs, the author deductively assessed the 56 papers that reported 58 studies (refer to Table 2). First, e-learning resources and networks, electronic gadgets, and digital instruments for L2 speaking development were covered in "Technologies for L2 Speaking Development." The sub-codes were created using the classification of contemporary technology for L2 speaking by Golonka et al. (2014) and Shadiev and Yang (2020), which included interactions, games, automated machines, electronic books, and more. The primary approach employed by the researcher for

coding this category was to study the literature studies and methodology portions of the analyzed papers, which focused on the kinds, characteristics, and benefits of digital technology for L2 speaking development. "Learning tasks for TESD" was the second code, and it dealt with the students' digital activities for improving their L2 speaking skills. The sub-codes were created using the L2 speaking development activities listed by Chau (2021), which included taking notes, observing, and text analysis. The author focused on the study plans and learner obligations in TESD and classified this group after reading the

methodologies portions and literature reviews of the 56 papers. The third code, "Outcomes of TESD," dealt with how TESD impacted students' emotional and academic states. The sub-codes were categorized into favorable,

neutral, unfavorable and hybrid impacts (Zhang and Zou, 2021a, 2021b). After reading the comments and findings sections and emphasizing the TESD results and their causes, the researcher classified this group.

Table 2: Coding Technique

Codes	Sub-codes	Sections
Technology for the improvement of L2 speaking	Automated machines, conversations, electronic books, games, and others (Shadiev & Yang, 2020)	Evaluation of the literature; Methodology
TESD coursework assignments	Taking notes, observing, text analysis non-reciprocal tasks, etc. (Chau (2021).	Review of the literature; Methodology
Results of TESD	Favorable, neutral, unfavorable and hybrid impacts (Zhang and Zou, 2021a, 2021b).	Findings and Comments

The researcher first examined seven studies before he concluded his interpretation and the best way to code the articles. The remaining papers were then examined by the author. After comparing the coding findings, it was determined that there was good reliability (Pearson's $r = 0.90$). Any remaining discrepancies were settled by thorough crosschecking.

IV. RESULTS AND DISCUSSION

4.1 Digital Technologies for L2 Listening Development

The author listed various digital resources, to answer research question 1, that are employed to improve L2 speaking (Refer to Figure 2) while emphasizing how language acquisition is changing as a result of these tools. Pronunciation aids and interactive activities are easily accessible using MALL (Metruk, 2024). Chatbots and virtual language partners are two examples of artificial intelligence (AI) systems that offer individualized feedback and encourage the use of active communication (Shafiee Rad, 2024). Students can participate in conversations on asynchronous video discussion platforms, whichs improve group learning (Jaramillo Cherez & Nadolny, 2023). By immersing students in realistic circumstances, VR settings help to lessen the anxiety that comes with public speaking (Chen, 2022). Applications for augmented reality (AR) and computer-aided pronunciation training (CAPT) provide both visual and aural assistance for practicing pronunciation (Sinyagovskaya & Murray, 2021; Sinyagovskaya, 2022; Wang et al., 2024). Speech recognition tools (McCrocklin, 2016; Evers & Chen, 2022; Jiang et al., 2023; Kholis, 2021;

Kang et al., 2024) offer instant feedback on pronunciation, grammar, and fluency. For L2 speakers, the combination of these technologies with well-established pedagogical frameworks has the potential to produce individualized, interesting, and productive educational activities.

The author examines several digital tools that are used to improve L2 speaking, highlighting how these technologies are changing the face of language acquisition. Pronunciation aids and interactive exercises are easily accessible via mobile-assisted Language Learning (MALL) (Metruk, 2024). Chatbots and virtual language partners are examples of artificial intelligence (AI) systems that provide individualized feedback and encourage conversation (Shafiee Rad, 2024). Students can participate in group discussions on asynchronous video discussion platforms, which improves collaborative learning (Jaramillo Cherez & Nadolny, 2023). By immersing students in realistic events, virtual reality (VR) environments help students overcome their fear of public speaking (Chen, 2022). Applications for computer-aided pronunciation training (CAPT) and augmented reality (AR) offer both visual and aural support for pronunciation practice. Speech recognition software provides real-time input on grammar, fluency, and pronunciation. By combining these technologies with well-established pedagogical frameworks, educational activities for L2 speakers can be made more individualized, interesting, and successful. MALL makes interactive activities and pronunciation aids easily accessible (Metruk, 2024).

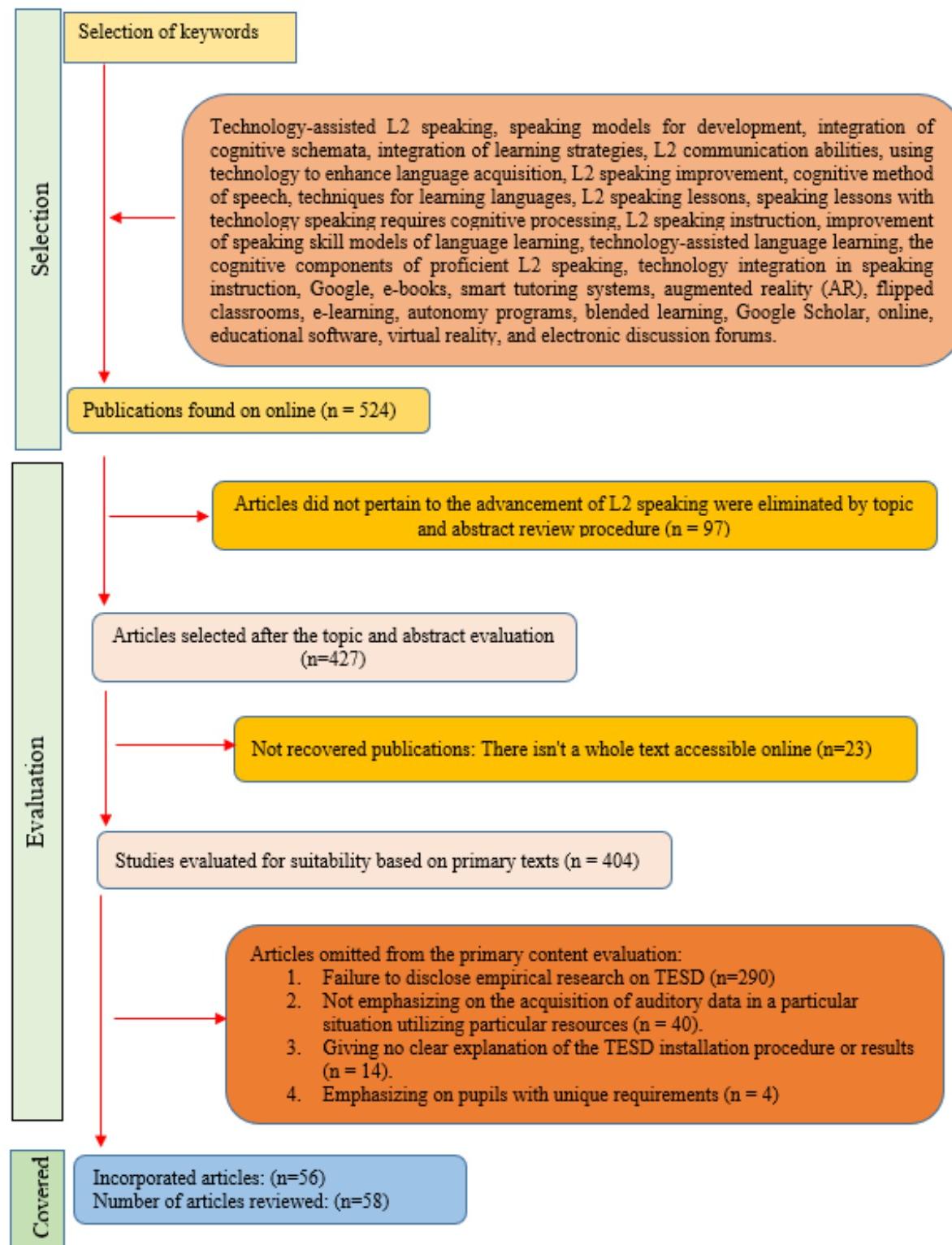


Fig.1

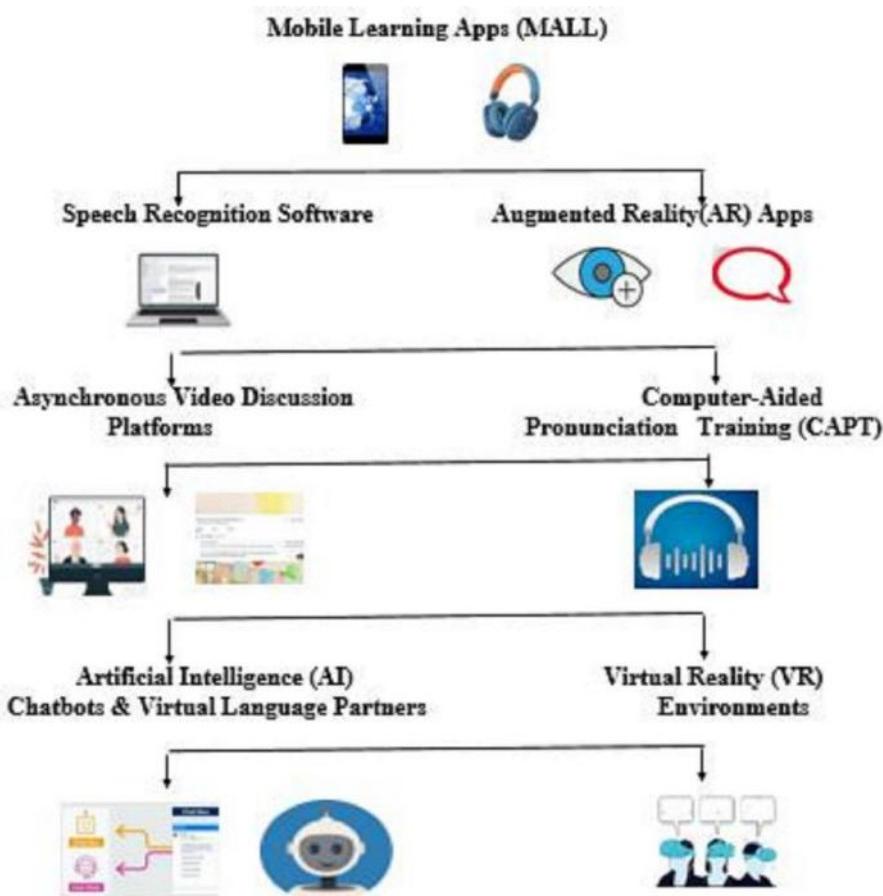


Fig.2: Numerous Articles Examining Various Digital Technology Models for L2 Speaking Improvement

Two examples of artificial intelligence (AI) systems that provide personalized feedback and promote the use of active communication are chatbots and virtual language partners (Shafiee Rad, 2024). Asynchronous video discussion platforms allow students to engage in dialogue, which enhances group learning (Jaramillo Cherrez & Nadolny, 2023; Rofi'I & Herdiawan, 2024). Virtual reality environments help students feel less nervous about public speaking by immersing them in realistic situations (Chen, 2022). Applications for computer-aided pronunciation training (CAPT) and augmented reality (AR) offer pronunciation practice in both visual and auditory ways (Sinyagovskaya & Murray, 2021; Sinyagovskaya, 2022; Wang et al., 2024). Speech recognition software (McCrocklin, 2016; Evers & Chen, 2022; Jiang et al., 2023; Kholis, 2021; Kang et al., 2024) provides real-time feedback on grammar, fluency, and pronunciation. Combining these technologies with tried-and-true pedagogical frameworks can result in customized, engaging, and fruitful learning experiences for L2 speakers.

4.2 Learning Tasks for TESD

In response to Research Question 2, the author selected 17 educational activities that were employed for TESD (see Figure 3). The most common learning activities were understanding activities, which were employed in 45 studies. Other common learning activities included linguistic curriculum (19 studies), team discussions (12 studies), lessons on speaking techniques (12 studies), overview and a reflection (10 studies), written evaluation (10 studies), non-reciprocal activities (10 studies), interacting with computers (10 studies), pre-speaking prompts and estimation drawing (8 studies), conversations recording and dissemination (6 investigations), role-playing (5 studies), taking notes (5 studies), observing (5 studies), open discussion (4 studies), transcribing (4 studies), lessons on foundational information (4 studies), conversations with native speakers (Kato et al., 2016) (2 studies). Since some research used multiple tasks, the total surpasses 58.

For the improvement of speaking, the author outlined four primary goals for each of the 17 various educational activities. The development of speaking-related knowledge was the primary goal. Six assignments were used in this regard: (a) Language knowledge guidance,

which covered topics like pronunciation (Maulana et al., 2024; Bashori et al., 2024), vocabulary (Opelia, 2024), and syntax (Sabir et al., 2021); (b) Speaking methods directions, which covered topics like self-evaluation and identifying sentence boundary pauses (Vetchinnikova et al., 2023); (c) Basic understanding instruction, which increased students' proficiency with the speech's content (Vetchinnikova et al., 2023); (d) open discussion (Q&A), where students gained knowledge by posing instructors questions and getting clarifications and suggested answers (Agbatogun, 2014); (e) team discussion, where students learned through conversations with their peers (Jaramillo Cherrez & Nadolny, 2023; Yudiati & Annisa, 2024); and (f) transcript analysis, where students had to study by looking at transcripts (Cowie, 2018).

Supporting speaking skills in activities was the second goal. Students participated in group or individual technology-enhanced activities (Cowie, 2018; Hsu et al., 2021). For this goal, five activities were applied: (a) Role-playing, which entailed having students adopt different characters and participate in dialogues or scenarios to practice speaking in a variety of settings. (Timpe-Laughlin et al., 2022); (b) picture descriptions, in which students had to describe images or photos, with an emphasis on honing their ability to give thorough and evocative oral explanations (Lavalle & Briesmaster, 2017; Mutiara, 2023); (c) storytelling, in which students had to share anecdotes or narrated stories, with an emphasis on storytelling techniques and holding the attention of the audience (Fu et al., 2022); (d) debates, which required students to investigate and argue opposing sides of an issue, strengthening their capacity to convey their views vividly and persuasively (Nurakhir et al., 2020) and (e) speeches or presentations, which required students to prepare and deliver speeches or presentations on a topic of interest, improving their public speaking skills (Sabdani-Asiri et al., 2024; Picanço Marchand et al., 2024).

Enabling speaking practice in spoken encounters was the third goal. To achieve this, four tasks were employed: (a) role-playing, in which pupils took on the roles of personalities and interacted with one another in L2 situations, honing their speaking skills in real-life situations (Suban, 2021; Jendli & Albarakati, 2024); (b) conversations with L1 speakers, in which learners were involved in L2 conversations with native speakers, offering an authentic

speaking experience (Kato et al., 2016); (c) conversation documenting and distributing, in which pupils recorded their speech, distributed it with other students, and enjoyed listening to their classmates, enabling peer feedback and self-evaluation (Chien et al., 2020); and (d) interacting with computers, in which learners engaged in L2 spoken interactions with computer programs, offering a low-pressure environment for speaking practice. (Fathi et al., 2024) and (e) collaborative storytelling, where students work together to write and narrate stories. This activity required them to improve their storytelling abilities and participate in meaningful verbal exchanges (Shaban & Junejo, 2024).

The fourth goal was to direct and promote the use of speaking strategies. To achieve this, there were five tasks: (a) pre-speaking prompts and prediction making, which asked students to anticipate and talk about the content of their speech to assist them to plan their speaking strategy and organize their thoughts (Zadnikar, 2024); (b) pre-speaking understanding recollection, which helped learners remember vocabulary and pertinent information connected to their speaking subject to prepare them for effective communication (Loizou, 2024); (c) overview and reflection, which asked students to evaluate their performance, pinpoint fields for enhancement, and reinforce effective speaking strategies (Mohammed, 2024); (d) peer feedback, which allowed students to offer their peers comments on how well they spoke, promoting introspection and the use of persuasive speaking techniques (Loizou, 2024). and (e) role-playing exercises, which helped students employ particular speaking techniques, like persuasion or negotiation, in a simulated real-life setting. This improved their ability to use these techniques successfully in real conversations (Yudiati & Annisa, 2024).

4.3 TESD Findings

The current study evaluation determined the overall benefits of TESD (Figure 4) to treat RQ3. 32 articles (80%) of the forty studies that examined educational results revealed substantial beneficial findings, two (5%), neutral results, and six (15%) showed mixed results. Of the 28 research investigations that looked into the perceptual results, 25 (89%) revealed substantial positive findings, and 3 (11%) indicated neutral outcomes.

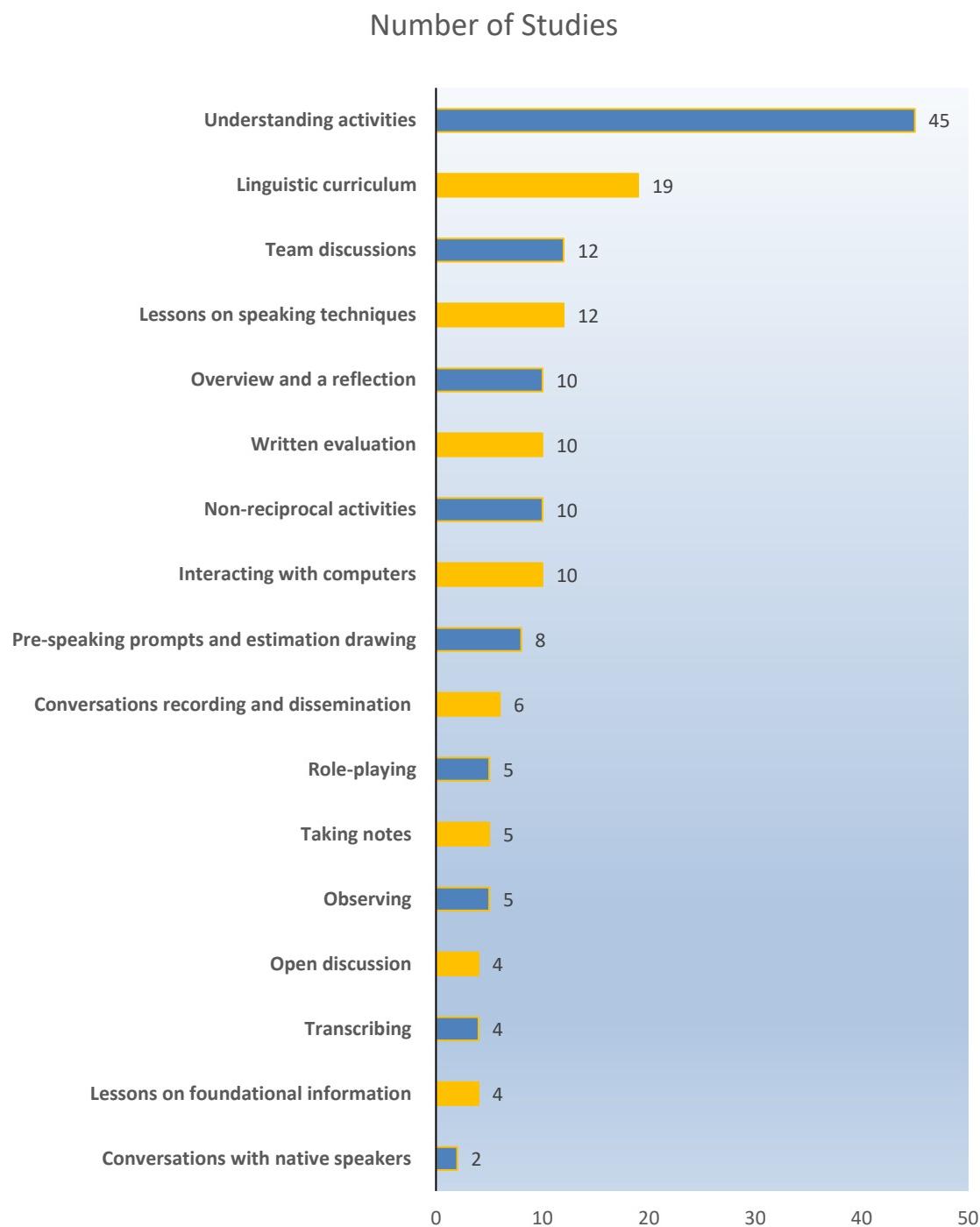


Fig.3: Study Representing Various TESD Activities

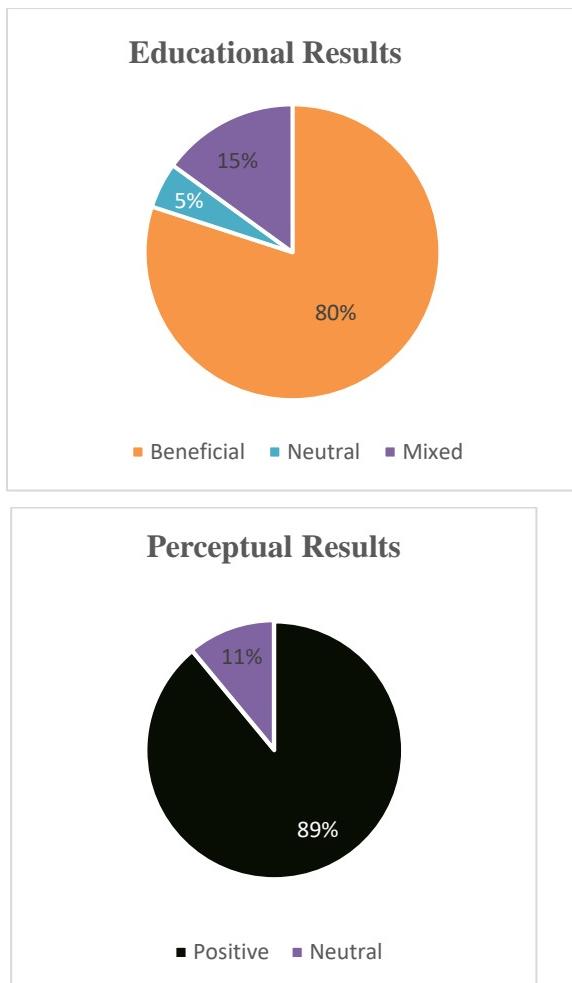


Fig.4: Benefits of TESD

4.4 Justification for the Efficacy of TESD

The usefulness of TESD in enhancing L2 speaking abilities is investigated in this analysis. According to the findings, TESD provides a variety of learning activities that meet different objectives and increase L2 speaking fluency. Seventeen unique TESD learning activities were found to be used in different research projects (Pitura, 2022). The activities cover a wide range of topics and focus on many facets of L2 speaking. Learners' comprehension of the fundamental elements of spoken language is improved through activities like open discussions and language knowledge assistance, which focuses on pronunciation, vocabulary, and grammar (Maulana et al., 2024; Bashori et al., 2024; Opelia, 2024; Agbatogun, 2014). Role-playing, visual descriptions, storytelling, debates, and other activities give students the chance to practice speaking in a variety of settings, improving their fluency and promoting effective communication (Suban, 2021; Jendli & Albarakati, 2024).

TESD activities that provide realistic speaking settings and encourage interaction, such as conversing with

native speakers, recording and sharing conversations, and engaging with computers, can help develop fluency and confidence in speaking (Kato et al., 2016; Chien et al., 2020; Fathi et al., 2024). Learners are encouraged to develop and apply good speaking strategies through activities such as pre-speaking comprehension memory, overviews with reflection, and prediction-making prompts (Zadnikar, 2024; Loizou, 2024; Mohammed, 2024). Because of its versatility, TESD may effectively meet a range of learning goals by helping L2 speakers acquire new information, hone existing skills, get real-world speaking experience, and build their strategic competence. The study also emphasizes how TESD improves L2 speaking results. TESD has been linked to significant improvements in educational results in 80% of the 40 studies that were analyzed. In a similar vein, 89% of research looking at learner perception reported having a good experience using TESD. These results imply that TESD interventions are generally well-received by students and effectively enhance learners' L2 speaking skills.

TESD is superior to conventional L2 speaking training techniques in several ways. Pronunciation guides and interactive exercises are easily accessible through mobile applications (MALL), enabling individualized learning outside of the classroom (Metruk, 2024; Li, 2024). When combined with asynchronous video discussions and virtual reality environments, TESD activities make for a more dynamic and interesting learning environment than when using only textbook-based methods (Chen, 2022; Jaramillo Cherez & Nadolny, 2023). Learners can receive tailored feedback on pronunciation, grammar, and fluency from tools such as chatbots and speech recognition software, which encourages self-correction and progress (Shafiee Rad, 2024). virtual reality (VR) environments can mimic real-world situations, enabling students to practice speaking in a secure setting. This can be especially helpful for learners who are afraid of public speaking (Chen, 2022).

Hence, the study that is being presented offers strong proof of the effectiveness of TESD in improving L2 speaking abilities. Many learning activities address different facets of speaking development, and the successful results shown in the research bear out the efficacy of TESD interventions. Moreover, TESD has notable benefits in comparison to conventional techniques, rendering it an invaluable resource for instructors and students aiming to enhance their L2 oral communication skills.

4.5 The Barriers to TESD's Efficacy

With so many platforms and tools available to improve second language (L2) proficiency, technology has become an essential component of language learning. TESD has drawn a lot of interest in language instruction in recent years. However, TESD's efficacy is hampered by

several issues, despite its apparent advantages. This study explores a few of the major issues and offers suggestions for how to resolve them. Lack of access to digital resources and technology is one of the main problems. Inequality in access to computers, smartphones, and high-speed internet hinders students' capacity to participate fully in TESD activities. Existing educational gaps are made worse by the digital divide, which calls for creative solutions to ensure fair access for all students (Warschauer, 2003). The caliber of online resources for language learning presents another difficulty. Even while the internet has a plethora of materials, not all of them are excellent or suitable for use in teaching. Finding relevant resources that support their learning objectives and aims may be difficult for educators and students (Hubbard, 2008). Furthermore, because technology is developing so quickly, it is frequently necessary to update and revise old materials.

Moreover, a lack of support and training for teachers frequently undermines the effectiveness of TESD. A large number of language instructors lack the necessary training to effectively create TESD activities or incorporate technology into their lesson plans (Jones & Hafner, 2021). Educators must have continuous assistance and professional development opportunities to equip them with the skills and knowledge needed to integrate technology into the classroom. Furthermore, problems with engagement and motivation provide serious obstacles to TESD's efficacy.

Particularly in online or virtual settings where there may be less opportunity for connection and community, some students might not be motivated to participate in speaking exercises (MacIntyre et al., 2019). Creating dynamic and captivating TESD exercises that encourage cooperation and dialogue can assist in resolving this issue.

4.6 TESD Cognitive Schema

Because TESD and cognitive schema learning share common foci, the author created a TESD paradigm (see Figure 5) based on an ascending evaluation of the findings from the review. This paradigm is in line with Schneider et al. (2022) cognitive schema learning paradigm. According to the study's findings, students in TESD could choose speaking materials from a wealth of resources depending on their unique requirements and choices (Sabir et al., 2021). Additionally, they could utilize a variety of cognitive schema learning techniques (Schneider et al., 2022) and actively participate in TESD speaking tasks with a significant amount of command (Kato et al., 2016). These methods could include reflecting on speaking procedures (Wu & Wang, 2021) and modifying the speed and subject matter of their speaking exercise (Silvia, 2018). Additionally, based on concepts of cognitive schema learning, the researcher selected several TESD programs and evaluated their overall efficacy from educational and affective standpoints (Kondo et al., 2012; Mohammed, 2024). Therefore, creating TESD frameworks using a cognitive schema learning paradigm could be worthwhile.

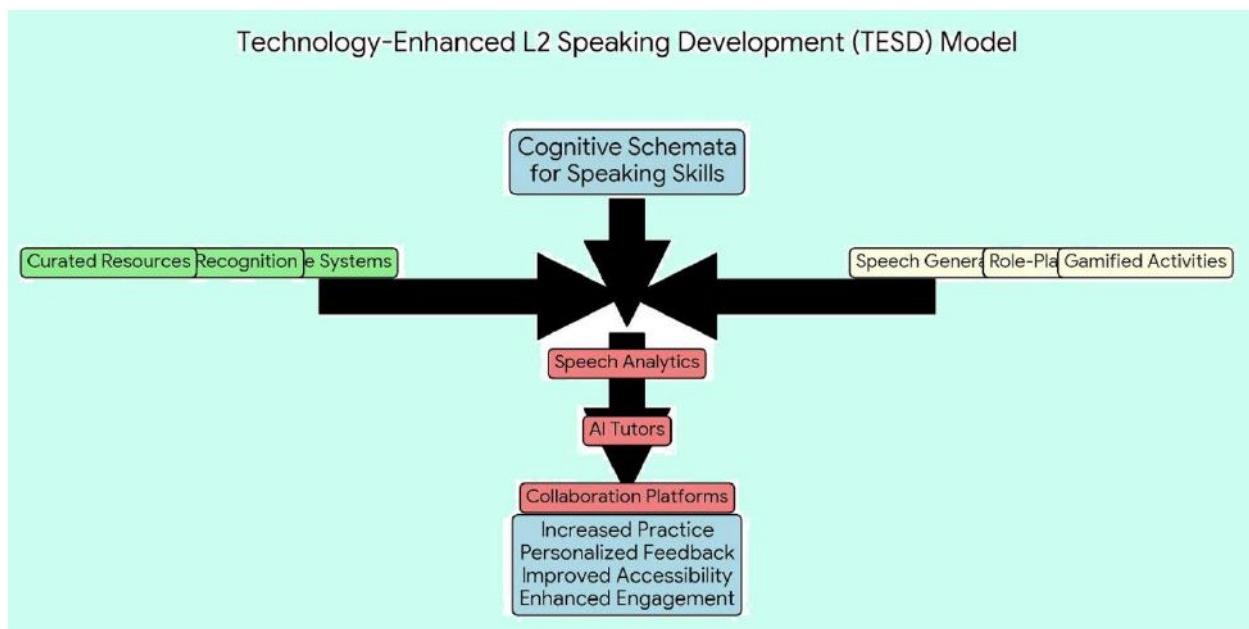


Fig.5

A thorough framework for TESD that incorporates multiple components to improve learners' speaking abilities is shown in the above picture of The Cognitive Schemata for the Speaking Skills paradigm. Primarily, the approach highlights the application of cognitive schemata—mental models that assist individuals in organizing and interpreting speech-related data. A variety of techniques and technologies are used to support these schemata to increase language learning's efficacy and efficiency (Schneider et al., 2022). The model's utilization of E-Systems, recognition, and curated materials is one of its main features. Resources that have been carefully chosen to be interesting and relevant for learners are known as "curated resources," and they offer a variety of learning opportunities. Recognition tools, such as certificates or badges, can inspire students and give them a feeling of accomplishment. E-Systems like, learning management systems and online platforms, provide a centralized location for tracking progress and accessing resources.

The approach also includes particular exercises and resources meant to improve speaking abilities. Role-plays and gamified activities imitate real-life speaking scenarios, making learning more interactive and interesting. Speech generators can assist learners in practicing pronunciation and intonation (Timpe-Laughlin et al., 2022). The model's essential elements are speech analytics and AI tutors, which provide students with tailored feedback depending on how well they talk (Kang et al., 2024). This personalized method aids students in pinpointing areas in need of development and monitoring their advancement over time. Through collaborative activities and peer and instructor interaction, collaboration platforms help students build community and improve their communication skills (Shaban & Junejo, 2024). A fundamental tenet of the approach is increased practice, which emphasizes the significance of regular and consistent practice in the development of speaking abilities. The capacity of learners to practice effectively is further enhanced by personalized feedback and increased accessibility to resources and support (Shafiee Rad, 2024).

4.7 Future Research Directions for TESD

A positive image is created by the research on TESD. 58 studies were analyzed, and the results show a variety of online resources and educational activities that successfully advance L2 speaking abilities. But there are difficulties in the field. Here, the researcher examines possible future paths for TESD with an emphasis on maximizing its advantages and resolving its drawbacks. An important future direction is highlighted by the cognitive schemata learning-based TESD model that has been developed. TESD can encourage a sense of ownership

and motivation by giving students authority over their learning resources, approaches, and task complexity. Subsequent investigations may examine methods for further tailoring learning experiences. Creating adaptive learning platforms that suggest materials and activities in response to each learner's needs and development could be one way to achieve this (Shaban & Junejo, 2024). Furthermore, developing learner autonomy calls for strong self-evaluation abilities (Chien et al., 2020). By incorporating self-assessment techniques and tools into TESD programs, teachers may enable students to recognize their areas of strength and weakness and create individualized progress targets.

Ensuring fair access to technology and resources is a major concern for TESD. Already existing disparities in schooling may be made worse by the digital divide. Future studies should look into how to improve the accessibility of TESD activities and tools for students using antiquated technology or with poor internet connectivity. This can entail creating learning activities that are available offline, using low-bandwidth apps, and looking into alternate access locations like libraries or community centers. The ability of teachers to successfully incorporate technology into their lessons determines how effective TESD is. Subsequent endeavors ought to concentrate on furnishing educators with continuous professional growth prospects to enhance their technological proficiency and pedagogical abilities for TESD. This could entail developing mentorship programs, workshops, and online resources to provide educators with the skills and assurance they need to create TESD activities that are both interesting and successful.

Successful language learning requires maintaining students' enthusiasm and involvement, especially in virtual or online environments. Potential avenues for future research include gamifying and enhancing the interactivity of TESD activities. This could entail introducing possibilities for peer engagement, cooperative learning assignments, and game-based aspects. Furthermore, encouraging a feeling of community in online learning environments might improve motivation and involvement. A more encouraging learning atmosphere can be produced by creating virtual areas where students can interact, exchange experiences, and recognize each other's accomplishments.

The "Cognitive Schemata for Speaking Skills" paradigm places a strong emphasis on the value of processing and organizing speech-related information using mental models. Subsequent investigations may explore further the cognitive mechanisms underlying L2 speaking and the most effective ways in which technology might assist these mechanisms. This would entail investigating

how artificial intelligence (AI) might be used to tailor education to each student's unique cognitive preferences and learning requirements. Furthermore, studies on the efficacy of different speech analytics tools and feedback systems might help design more impactful and customized learner support. To maximize the benefits of TESD, it is crucial to close the gap between research and practice. Subsequent endeavors ought to be focused on distributing study outcomes and optimal methodologies to teachers of languages and curriculum designers. This could entail setting up professional learning communities for teachers, compiling online databases of useful TESD activities, and formulating evidence-based standards for incorporating technology into L2 speaking practice.

V. CONCLUSION

This study looked at how well TESD can help with L2 speaking proficiency improvement. After 58 studies were analyzed, 17 different digital tools and learning activities were shown to be beneficial in promoting speaking fluency. These exercises focus on a range of speaking development domains, including language proficiency and pragmatic application. Additionally, the study discovered that TESD treatments are often well-received and result in notable gains in learners' speaking abilities. This study adds credence to the increasing amount of data demonstrating TESD's efficacy. It draws attention to the variety of learning activities that TESD offers and its beneficial effects on students' speaking abilities (Schneider et al., 2022). Furthermore, the suggested model—the Cognitive Schemata for Speaking Skills model—offers a helpful framework for creating and executing TESD programs. TESD can significantly change L2 speaking training. TESD can produce interesting and productive learning experiences for everyone by supporting learner autonomy, addressing accessibility concerns, and cultivating a positive learning environment. Subsequent investigations ought to concentrate on refining the technological instruments and instructional strategies within TESD to ensure its sustained efficacy in enhancing L2 speaking skills worldwide.

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